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COMPARISON OF PROTEIN, MINERALS AND VITAMIN C CONTENTS OF SOME DRIED LEAFY VEGETABLES

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The proximate analysis for protein, minerals and vitamin C contents in twelve different dried leafy vegetables usually grown for preparation of soup were carried out. The results showed that the protein content on dry matter basis varied from 21.51% in Tete atetedaye *(Amaranthus candatus)* to 37.21% in "Soko" *(Celosia argentea)*. The vegetables were rich in minerals, which varied from sample to sample. "Ila" *(Hibiscus esculentus* LD*)* was found to be richest in magnesium and sodium, "Ewedu" *(Chorchorus oiltorus)* had the highest value for calcium and manganese, "Igbagba" *(Solanum macrocarpum)* showed the highest value for iron while "Soko" *(Celosia argentea)* was found to be richest in potassium "Tete dudu" *(Amaranthus cruentus)* and "Ewure" *(Vernocia amygdalima)* were found to have the highest values for phosphorus. The vitamin C content in the dried leaves was found to be dependent on the temperature of drying and was found retained in appreciable quantity even on drying at 75°.

Key words: Protein, Minerals, Vitamin C.

Introduction

Emphasis has been laid by food chemists and nutritionists on the value of vegetables in maintaining adequate health standard [1-5]. In most developing countries, animal protein intake is on decline and so it becomes necessary to look for an alternative sources of good quality protein. Thus attempts had been made by earlier workers [2,3,6,7] to improve the protein level and quality of foods which are commonly consumed in developing countries by using some plant proteins.

Some minerals which are essential for biochemical activities in human body can be found in some leaf tissues [8] and thus serve as an alternative to animal sources of such minerals.

Leafy vegetables are important sources of vitamin C intake by humans and animals. They are consumed in various cooked dishes, especially soups and stews [4]. Much of the vitamin C is usually lost in the process of blanching or cooking in boiling water before addition to the boiling soup. The losses in vitamin C due to blanching ranges between 59-81% [4]. Some amount of vitamin C is also lost when leafy vegetables are allowed to wilt for 36 hrs [4]. Thus leafy vegetables usually depreciate appreciably in terms of vitamin C if they are not prepared into soup when they are fresh. Low temperature preservation is not yet wide spread in developing countries due to cost of refrigerators in relation to income.

Drying has been one of the cheapest method of food preservation. This method is being used by many local farmers in Nigeria to preserve leafy vegetables but the effect of drying on the nutrient composition of some of the preserved leafy vegetables has not been reported. The present report compares the protein, minerals and temperature dependence of vitamin C of some dried leafy vegetables commonly used for preparation of soup in Nigeria.

Experimental

Freshly harvested leafy vegetables were obtained from farm around the University Campus at Akure, Nigeria in the morning to avoid loss of vitamin C accompanying wilting [4]. The fresh leaves were cut into pieces and each sample was divided into three groups. Group one was dried at 45° for 48 hrs, group two was dried at 75°for 24 hrs, while, group three was dried at 100° for 8 hrs. The drying was carried out in an oven. The dried samples were ground into powder and kept in polythene bags for analysis.

Proximate analyses for moisture and ash were carried out using the method described by AOAC [9]. Nitrogen was determined by the micro-kjeldahl method described by Pearson [10] and was converted to crude protein multiplying by 6.25.

Minerals were determined by preparing standard solutions of the ash using distilled deionised water with few drops of concentrated HCl and used as stocked solution. Sodium and potassium were determined using a corn 411 flame photometer, magnesium, manganese, calcium, iron, and lead were determined by means of atomic absorption spectrophotometer (SP 9) while phosphorus was determined colorimetrically using spectronic 20, as described by Pearson [10]. Vitamin C was determined using the method of Pearson [10].

Standard ascorbic acid was prepared from standard sample obtained from BDH (British Drug House) using metaphosphoric acid - acetic acid solution, while 2, 6-dichloroindophenol solution was prepared from its sodium salt by dissolving 50 mg of it in 50 cm^3 of distilled water containing 42 mg sodium carbonate, shaken vigorously to dissolve the dye and diluted to 200 cm^3 with distilled water and filtered. The indophenol solution was standardised by titration against

the standard ascorbic acid solution and the two standard solutions were stored in refrigerator. The dried vegetable samples were pulverised by gentle grinding, added HPO_3-HOAc/g of dried sample and filtered. Samples aliquots were titrated with the standard indophenol solution. Blank titrations were carried out using equivalent amount of extraction solution.

Results and Discussion

The results in Table 1 show the values obtained for moisture, ash and protein content of the samples. The percentage protein in the dried samples ranged from 37.21 in "Soko" *(Celosia argentea)* to 21.51 in "Tete atetedaye" *(Amaranthus candatus)*. This drying method may serve as an alternative method of obtaining leave protein concentrate [2] and can be used to improve the protein intake during the dry season when farmers in developing countries are usually short of leafy vegetables due to lack of refrigeration facilities. It is observed that the dried form of these leaves are richer in protein than many dried cereals [11]. In addition, it has been shown that the essential amino acid composition of leafy protein is comparable with other good quality sources [1]. Therefore, some of the dry leafy vegetables with high protein content may be used as protein concentrate. Therefore, some of dry leafy vegetables with high protein content may be used as protein concentrate for the production of animal rations.

Table 2 shows results obtained for the minerals determined for the samples. Sodium, potassium and magnesium were the most abundant and varied depending on type of sample and mineral being considered. Iron, calcium, manganese and phosphorus were present at lower concentrations than the three cosidered above but also varied depending on the type of sample and mineral being considered. The degree of variation was least for phosphorus. Iron and calcium which are very important to animals, are least abundant. Contrary to earlier report [8], Table 2 shows that magnesium was more abundant than calcium in all the samples analysed but agrees with the report of Teizo *et al* . [5].

Table 3 shows the values obtained for the vitamin C content of each sample after drying at 45, 75 and 100°. The values obtained were in the ranges of 519mg/100 g to 325mg/100 g for samples dried at 45°, 515 mg/100g to 302 mg/100 g for samples dried at 75° and 446 mg/100 g to 205 mg/100 g for samples dried at 100°. With exception of "Aminututu" *(Basella alba)*, the loss in vitamin C is not very high at temperature up to 75° compared with the reports of Ajayi et *et al.* [4], who reported the vitamin C for some samples dried at lower temperature. In addition vitamin C losses were lower than those losses due to the usual blanching of the leaves before their addition to soup [4]. The vitamin C content of "Ewe ege" *(Manihot utilisima)* Igbagba *(Solanum macrocarpum)* "Odu" *(Solanum nigrum* L*)* and "Gbologi" *(Amaranthus viridis)* which had not been reported previously is also shown in Table 3 to be encouragingly stable at temperatures up to 75°. The results in Table 3 further show that drying the vegetables at 100° resulted into significant loss of vitamin C. Therefore, it is not advisable to dry these vegetables at 100°.

Usually, the temperature of drying leafy vegetables in the sun in Nigeria is between 30 and 35° and takes about 5 to 7 days to dry. The number of days for drying the vegetables during the period of abundance (during the rainy season) for preservation for use during the dry season can be reduced to about 1-2 days of continuous drying depending on type of leafy vegetables, by

TABLE 1. MOISTURE, ASH AND CRUDE PROTEIN OF THE LEAFY VEGETABLES.

Sample number	Local names	Botanical names	Moisture in fresh sample (%)	Ash in dried sample (%)	Crude protein in dried sample (%)
1	Ewedu	*Chorchorus oiltorus*	80.05±0.02	0.46±0.01	35.42±0.02
2	Soko	*Celosia argentea*	79.53±0.01	0.39±0.03	37.21±0.01
3	Ewure	*Vernocia amygdalima*	76.71±0.03	0.34±0.02	32.37±0.02
4	Tete dudu	*Amaranthus cruentus*	78.91±0.01	0.49±0.01	27.67±0.02
5	Ila	*Hibiscus esculentus*	70.56±0.02	0.38±0.02	24.31±0.01
6	Gbure	*Talium triangulare*	89.71±0.03	0.52±0.01	26.98±0.03
7	Tete atetedaye	*Amaranthus candatus*	78.54±0.01	0.36±0.01	21.51±0.03
8	Aminututu	*Basella alba*	82.28±0.01	0.44±0.02	24.38±0.02
9	Ewe ege	*Manihot utilisima*	72.58±0.03	0.33±0.03	30.77±0.01
10	Igbagba	*Solanum macrocarpum*	78.95±0.02	0.54±0.01	36.89±0.03
11	Odu	*Solanum nigrum* L.	82.05±0.01	0.45±0.01	31.06±0.01
12	Gbologi	*Amaranthus viridis*	78.11±0.02	0.42±0.02	26.40±0.03

Values are means of at least triplicate determinations while errors are computed as standard errors.

TABLE 2. SOME MINERAL CONTENTS OF THE DRIED VEGETABLES (g/100g).

Sample No.	Mg	Ca	Fe	Mn	Na	K	P
1	6.41	0.16	0.13	0.16	6.80	5.52	0.35
2	4.23	0.02	0.03	0.02	7.01	12.88	0.25
3	3.02	0.08	0.11	0.14	6.82	6.80	0.69
4	1.84	0.16	0.10	0.03	2.56	33.21	0.16
5	0.09	0.09	0.16	0.03	11.28	2.08	0.18
6	3.22	0.03	0.15	0.04	6.41	5.92	0.17
7	2.61	0.08	0.17	0.16	4.83	4.03	0.35
8	6.18	0.09	0.12	0.14	8.40	3.56	0.17
9	6.45	0.07	0.03	0.03	2.56	3.21	0.68
10	3.21	0.16	0.16	0.14	4.48	2.40	0.36
11	5.67	0.11	0.07	0.16	3.64	3.91	0.32
12	3.63	0.13	0.16	0.16	3.84	2.47	0.17

Serial numbers correspond to those in Table 1 with samples names. The standard errors computed for triplicate determination were less than ±0.01.

TABLE 3. VARIATION OF VITAMIN C WITH TEMPERATURE OF DRYING THE VEGETABLES (mg VITAMIN C/100g DRY WEIGHT OF SAMPLES).

Sample No.	45°	75°	100°
1	444.21±0.06	420.50±0.02	319.81±0.02
2	465.18±0.08	452.01±0.07	325.53±0.04
3	430.36±0.08	415.18±0.07	285.16±0.07
4	355.11±0.03	345.22±0.02	214.62±0.03
5	344.78±0.02	325.11±0.05	254.48±0.03
6	404.24±0.01	395.24±0.02	255.51±0.02
7	525.90±0.04	507.13±0.03	332.12±0.03
8	519.06±0.03	305.71±0.06	205.71±0.05
9	315.41±0.02	305.28±0.03	225.84±0.02
10	398.12±0.02	376.14±0.03	254.43±0.06
11	452.34±0.05	434.73±0.04	254.43±0.03
12	325.34±0.04	304.51±0.03	225.92±0.03

Serial numbers correspond to those in Table 1 with samples names. Values are means of at least triplicate determinations while errors are computed as standard errors.

using a drier at a temperature not higher than 75° and still substantially retain the vitamin C. The dried vegetable can be kept in sealed polythene bag as a protective measure against oxygen which may affect the shelf life of the vitamin C because there is a likelihood of vitamin C being oxidized in presence of oxygen [4].

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